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Poly-genetic stratigraphically controlled hydrocarbon accumulation within the Montney Formation, British Columbia: molecular, stable carbon isotope and petrographic evidence

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Summary

The vast majority of hydrocarbons producing from the Montney Formation in British Columbia are considered to be originated from the thermal degradation of migrated hydrocarbons (e.g. Sanei et al., 2015; Wood and Sanei, 2016). However, uncertainties remain regarding how migrated hydrocarbons originally were distributed before degradation, as well as how hydrocarbon mixing (i.e. several migration stages) enabled the occurrence of highly productive stratigraphic intervals. In this study, we provide molecular, stable carbon isotopes, and petrographic data that answer some of these questions. Using samples from a core in British Columbia, we describe how within a 40 m section, one to two hydrocarbon charges accumulated in different stratigraphic intervals without thermal maturity control. Thermal degradation also seemed to occur in at least two stages (two solid bitumen populations). Hydrocarbon distribution within the Montney Formation is complex and the geochemical properties of produced fluids are often a representation of poly-genetic hydrocarbon accumulation that requires a rather detailed approach.

Method

A total of 8 core samples were analyzed by programmed pyrolysis (HAWK™ TOC analyzer) and organic petrography. Soluble hydrocarbons were extracted from the same samples using Soxhlet, and the extracts were fractionated into aliphatic and aromatic hydrocarbons using small-scale silica–liquid chromatography for their analysis via standard methods for gas chromatography–mass spectrometry (GC–MS). The aliphatic fractions were also analyzed using gas chromatography – isotope ratio mass spectrometry (GC–irMS) for stable carbon compound specific isotope analysis.

Results

Two prominent hydrocarbon accumulations have been identified within the 40 m core. An early accumulation corresponds to a thermal-degradation hydrocarbon residue containing abundant polycyclic aromatic hydrocarbons, more positive $\delta^{13}C$ values, and a reverse *n*-alkanes carbon isotope profile. This charge is present in higher porosity areas containing more mature solid bitumen. In other intervals, this early charge (where present) is mixed with a less mature hydrocarbon input that exhibits more negative $\delta^{13}C$ values, a mixed *n*-alkanes carbon isotope profile, as well as more abundant low-molecular-weight aromatic compounds. This second charge seems to preferentially accumulate in lower-porosity sections of the core. Two phase of solid bitumen (lower and higher maturity) were also identified in sections where two hydrocarbon charges have been recognized.

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References

Sanei, H., Wood, J.M., Ardakani, O.H., Clarkson, C.H., Jiang, C. (2015). Characterization of organic matter fractions in an unconventional tight gas siltstone reservoir. International Journal of Coal Geology 150-151, 296-305.
Wood, J.M., Sanei, H. (2016). Secondary migration and leakage of methane from a major tight-gas system. Nature Communications 7(13614), 1-9.